The TSA has implemented the SPOT program, a security screening protocol that relies on observation of nonverbal and facial cues to assess the credibility of travelers. In particular, the program relies on behavioral indicators of "stress, fear, or deception" (GAO, p. 2). A key question is whether there is a scientifically validated basis for using behavior detection for counterterrorism purposes. This testimony will review the relevant empirical evidence on this question. In brief, the accumulated body of scientific work on behavioral cues to deception does not provide support for the premise of the SPOT program. The empirical support for the underpinnings of the program is weak at best, and the program suffers from theoretical flaws. Below, I will elaborate on the scientific findings of relevance for this issue.

Accuracy in deception judgments

For several decades, behavioral scientists have conducted empirical research on deception and its detection. There is now a considerable body of work in this field (Granhag & Strömwall, 2004; Vrij, 2008). This research focuses on three primary questions: First, how good are people at judging credibility? Second, are there behavioral differences between deceptive and truthful presentations? Third, how can people's ability to judge credibility be improved?

Most research on credibility judgments is experimental. An advantage of the experimental approach is that researchers may randomly assign participants to conditions, which provides internal validity (the ability to establish causal relationships between the variables, in this context between deception and a given behavioral indicator) and control of extraneous variables. Importantly, the experimental approach also allows for the

unambiguous establishment of ground truth, that is, knowledge about whether the statements given by research participants are in fact truthful or deceptive. In this research, participants provide truthful or deliberately false statements, for example by purposefully distorting their attitudes, opinions, or events they have witnessed or participated in. The statements are subjected to various analyses including codings of verbal and nonverbal behavior. This allows for the mapping of *objective cues to deception* – behavioral characteristics that differ as a function of veracity. Also, the videotaped statements are typically shown to other participants serving as lie-catchers who are asked to make judgments about the veracity of the statements they have seen. Across hundreds of such studies, people average 54% correct judgments, when guessing would yield 50% correct. Meta-analyses (statistical summaries of the available research on a given topic) show that accuracy rates do not vary greatly from one setting to another (Bond & DePaulo, 2006) and that individuals barely differ from one another in the ability to detect deceit (Bond & DePaulo, 2008). Contrary to common expectations (Garrido, Masip, & Herrero, 2004), presumed lie experts such as police detectives and customs officers who routinely assess credibility in their professional life do not perform better than lay judges (Bond & DePaulo, 2006). In sum, that judging credibility is a near-chance enterprise is a robust finding emerging from decades of systematic research.

Cues to deception

Why are credibility judgments so prone to error? Research on behavioral differences between liars and truth tellers may provide an answer to this question. A meta-analysis covering 1,338 estimates of 158 behaviors showed that few behaviors are

related to deception (DePaulo et al., 2003). The behaviors that do show a systematic covariation with deception are typically only weakly related to deceit. In other words, people may fail to detect deception because the behavioral signs of deception are faint.

Lie detection may fail for another reason: People report relying on invalid cues when attempting to detect deception. Both lay people and presumed lie experts, such as law enforcement personnel, report that gaze aversion, fidgeting, speech errors (e.g., stuttering), pauses and posture shifts indicate deception (Global Deception Research Team, 2005; Strömwall, Granhag, & Hartwig, 2004). These are cues to stress, nervousness and discomfort. However, meta-analyses of the deception literature show that these behaviors are not systematically related to deception. For example, in DePaulo et al. (2003), the effect size d (a statistical measure of the strength of association between two variables) of gaze aversion as a cue to deception across all studies is a non-significant 0.03. DePaulo et al. state: "It is notable that none of the measures of looking behavior supported the widespread belief that liars do not look their targets in the eye. The 32 independent estimates of eye contact produced a combined effect that was almost exactly zero ($d = 0.01$)" (p. 93). Moreover, fidgeting with object does not occur more frequently when lying, $d = -0.12$ (the negative value suggests that object fidgeting occurs less, not more frequently when lying, but this difference is not statistically significant), nor does self-fidgeting ($d = -0.01$) and facial fidgeting ($d = 0.08$). Speech disturbances are not related to deception ($d = 0.00$), nor are pauses (silent pauses $d = 0.01$; filled pauses $d = 0.00$; mixed pauses $d = 0.03$). Posture shifts are not systematically related to deception either, $d = 0.05$.

In sum, the literature shows that people perform poorly when attempting to detect deception. There are two primary reasons: First, there are few, if any, strong cues to deception. Second, people report relying on cues to stress, anxiety and nervousness, which are not indicative of deceit.

High-stake lies. Some aspects of the deception literature have been criticized on methodological grounds, in particular with regard to external validity (i.e., the generalizability of the findings to relevant non-laboratory settings, see Miller & Stiff, 1993) The most persistent criticism has concerned the issue of generalizing from low-stake situations to those in which the stakes are considerably higher. Critics have argued that when the deceit concerns serious matters, liars will experience stronger fear of detection, leading to cues to deception. There are several bodies of work of relevance for this concern. In a meta-analytic overview of the literature on credibility judgments (Bond & DePaulo, 2006), the evidence on the effects of stakes was mixed: *Within* studies that manipulated motivation to succeed, lies were easier to tell from truths when there is relevant motivation. However, the effect size was fairly small ($d = 0.17$). However, when the comparison was made *between* studies that differed in stakes, no difference in lie detection accuracy was observed. Also, the meta-analysis revealed that as the stakes rise, both liars and truth tellers seem more deceptive to observers. That is, lie-catchers are more prone to make false positive errors – mistaking an innocent person for a liar – when judging highly motivated senders.

Furthermore, research on real-life high-stake lies, such as lies told by suspects of serious crimes during police interrogations, shows that people obtain at best moderate hit rates when judging such material (for a review of these studies, see Vrij, 2008).

Behavioral analyses of the suspects in these studies do not support the assertion that cues to deception in the form of stress, arousal and emotions appear when senders are highly motivated. Vrij noted that the pattern from high-stake lies studies are "in direct contrast with the view of professional lie-catchers who overwhelmingly believe that liars in high-stake situations will display cues to nervousness, particularly gaze aversion and self-adaptors" (2008, p. 77). Moreover, he notes that the results "show no evidence for the occurrence of such cues" (2008, p. 77).

In sum, neither the research in general nor specific results on high-stake lies support the assumption that liars leak cues to stress and emotion, which can be used for the purposes of lie detection.

Verbal vs. nonverbal cues to deception

The SPOT program seems to rely heavily on evaluation of nonverbal cues. This emphasis on nonverbal behavior as opposed to verbal content cues runs counter to the recommendations from research. A number of findings suggest that reliance on nonverbal cues impairs lie detection accuracy. First, the meta-analysis on accuracy in deception judgments investigated accuracy under four conditions: a) watching videotapes without sound b) watching tapes with sound c) listening to audiotapes and d) reading transcripts (Bond & DePaulo, 2006). The accuracy rates in the first condition, where people based their judgments solely on nonverbal behavior, was significantly lower than in the other three, which did not differ significantly from each other. Thus, the combined results of hundreds of studies on lie detection suggest that having access to only nonverbal cues impairs lie detection accuracy.

Second, a number of studies have correlated lie-catchers' self-reported use of cues with lie detection accuracy. The purpose of such analyses is to investigate whether failure to detect deception coincides with the self-reported use of a particular set of cues. The results of these studies are consistent: They show that the more frequently a participant reports relying on nonverbal behavior, the less likely they are to be accurate in detecting deception. First, Mann et al. (2004) investigated police officers' ability to assess the veracity of suspects accused of murder, rape and arson. They found that successful lie detectors mentioned story cues (e.g., contradictions in the statement, vague responses) more frequently than poor lie detectors. Moreover, the more nonverbal cues the detectives mentioned (e.g., gaze aversion, movements, posture shifts), the lower their lie detection accuracy was. Second, Anderson et al. (1999) and Feeley and Young (2000) found that the more vocal cues lie-catchers mentioned, the more accurate they were in detecting deception. Third, Vrij and Mann's (2001) analysis of accuracy in judging the statement of a convicted murderer showed that the participants who mentioned cues to stress and discomfort obtained the lowest hit rates. Fourth, Porter et al. (2007) found that the more visual cues participants reported, the poorer they were at detecting deception.

It should be noted that reliance on nonverbal cues is associated not only with poorer lie detection accuracy, but also a more pronounced lie bias (a tendency to judge statements as lies rather than truths). That is, paying attention to visual cues increases the tendency for false positive errors – mistaking an innocent person for a deceptive one. This finding was obtained in one of the meta-analyses on deception judgments (Bond & DePaulo, 2006), as well as in a study of police officers' judgments of suspects of serious crimes (Mann et al., 2004).

The finding that reliance on nonverbal cues hampers lie detection is not surprising, given the research findings on cues to deception. These findings suggest that speech-related cues may be more diagnostic of deception than nonverbal cues (DePaulo et al., 2003; Sporer & Schwandt, 2006, 2007; Vrij, 2008). For example, DePaulo et al. (2003) showed that liars talk for a shorter time ($d = -0.35$), and include fewer details ($d = -0.30$). Liars' stories are also less logically structured ($d = -0.25$) and less plausible ($d = -0.20$). Liars and truth tellers differ in verbal and vocal immediacy ($d = -0.55$), and with respect to the inclusion of particular verbal elements, such as admissions of lack of memory ($d = -0.42$), spontaneous corrections ($d = -0.29$) and related external associations ($d = 0.35$). These findings are in line with predictions from content analysis frameworks (e.g., Köhnken, 2004).

Detecting deceptions from facial displays of emotion

Theoretical concerns. Parts of the SPOT program seem to be predicated on the assumption that analyses of facial displays of emotion can improve deception detection accuracy. The claims of effectiveness for such approaches are not modest. In an interview with the New York Times, Ekman claimed that "his system of lie detection can be taught to anyone, with an accuracy rate of more than 95 percent" (Henig, 2006). However, no such finding has ever been reported in the peer-reviewed literature (Vrij et al., 2010). More broadly, there is no support for the assertion that training programs focusing on identifying facial displays of emotions can improve lie detection accuracy (Vrij, 2008).

Apart from lack of empirical support for the effectiveness of training programs focusing on the analysis of facial displays of emotion, there are theoretical problems with

the approach. The assumption behind the training program is that concealed emotions may be revealed automatically, through brief displays sometimes referred to as microexpressions. Implicit in this assumption is the notion that liars will experience emotions, and that leakage of emotions can betray their deceit. This seems to equate cues to emotion with cues to deceit. But what is the evidence that lying will entail emotions, while truth telling will not? Several scholars have noted that the assumption that liars will experience emotion is a prescriptive view – it suggests how liars *should* feel. Common moral reasoning suggests that lying is "bad" (Backbier et al., 1997). In line with this reasoning, Bond and DePaulo (2006) proposed a *double-standard hypothesis* to explain the discrepancy between people's beliefs about deceptive behavior (that liars will display signs of discomfort and stress) and the actual findings on deceptive behavior (that liars typically do not display such signs). The double-standard hypothesis suggests that people have two views about lying: one about the lies they themselves tell, and one about the lies told by others (a form of fundamental attribution error; Ross, 1977). In the words of the authors: "As deceivers, people are pragmatic. They accommodate perceived needs by lying. […] [Lies] are easy to rationalize. Yes, deception may demand construction of a convincing line and enactment of appropriate demeanor. Most strategic communications do. To the liar, there is nothing exceptional about lying" (p. 216). However, people's view of the lies told by others is markedly different: "Indignant at the prospect of being duped, people project onto the deceptive a host of morally fuelled emotions – anxiety, shame, and guilt. Drawing on this stereotype to assess others' veracity, people find that the stereotype seldom fits. In underestimating the liar's capacity for self-rationalization, judges' moralistic stereotype has the unintended effect of enabling successful deceit.

Because deceptive torment resides primarily in the judge's imagination, many lies are mistaken for truths. When torment is perceived, it is often not a consequence of deception but of a speaker's motivation to be believed. High-stakes rarely make people feel guilty about lying; more often, they allow deceit to be easily rationalized. When motivation has an impact, it is on the speaker's fear of being disbelieved, and it matters little whether or not the highly motivated are lying (pp. 231-232)."

These are important points, in that they highlight the discrepancy between the perspective of the liar and the lie-catcher: People fall prey to an error of reasoning when assuming that the liars are plagued by emotions. They fail to take into account the pragmatic nature of lies, as well as the liar's ability to rationalize their lie. Moreover, they may misinterpret the fear of a motivated innocent person as a sign of deceit.

Beyond naïve moral reasoning about lies, is it psychologically sound to assume that people experience stress and negative emotion about lying? Can we expect that a criminal will experience guilt or shame about the actions he has committed, or that a prospective terrorist is plagued by negative feelings about the actions he is about to commit? They may, but given the double-standard hypothesis, we cannot be certain that this is the case. Apart from guilt and shame, it could be argued that liars may experience fear of not being able to convince. However, we must acknowledge the important fact that truth tellers might also experience such fear. For example, Ekman coined the term "Othello error" to describe how lie-catchers may misinterpret an innocent person's fear of not being believed as a sign of deception (Ekman, 2001). Moreover, people may react not only with fear but also anger in response to suspicion. Indeed, one study found that truth tellers reacted with more anger to suspicion than did liars (Hatz & Bourgeois, 2010). For

an innocent person, suspicion is obviously undeserved. An emotional reaction to such treatment fits with a large body of social justice research suggesting that people have affective responses to violations of fairness (De Cremer & van den Bos, 2007; Mikula et al., 1998).

Empirical support. In sum, the concern raised above is that equating arousal, fear and stress with deception may rest on shaky theoretical grounds. If one rejects this concern and insists that such processes accompany lying, there is yet another hurdle to overcome. If people do experience affective processes, can they conceal them? Given the attention to microexpressions in the media, one might assume that there is an abundance of research published in peer-reviewed journals addressing this question. However, this is not the case. Porter and ten Brinke (2008) noted that "to [their] knowledge, no published empirical research has established the validity of microexpressions, let alone their frequency during falsification of emotion" (p. 509). They proceeded to conduct an analysis of people's ability to a) fabricate expressions of emotions they did not experience and b) conceal emotions that they did in fact experience. Their results showed that people are not perfectly capable of fabricating displays of emotions they do not experience: When people were asked to present a facial expression different from the emotion they were experiencing, there were some inconsistencies in these displays. However, the effect depended on the type of emotion people were trying to portray. People performed better at creating convincing displays of happiness compared to negative expressions. This is plausibly due to people's experience of creating false expressions of positive emotion in everyday life. With regard to concealing an emotion people did in fact experience, they performed better: There was no evidence of leakage of

the felt emotion in these expressions. As for microexpression, no complete

microexpression (lasting 1/5th-1/25th of a second) involving both the upper and lower

half of the face was found in any of the 697 facial expressions analyzed in the study.

However, 14 partial microexpressions were found, 7 in the upper and 7 in the lower half

of the face. Interestingly, these partial microexpression occurred both during false and

genuine facial expressions. That is, not only those who were falsifying or concealing

emotions displayed these expressions; true displays of emotion involved

microexpressions to the same extent. Porter and ten Brinke concluded that the

"occurrence [of microexpressions] in genuine expressions makes their usefulness in

airline-security settings questionable, given the implications of false-positive errors (i.e.,

potential human rights violations). Certainly, current training that relies heavily on the

identification of full-face microexpressions may be misleading." (p. 513).

Passive vs. active lie detection

   If it is difficult, or even impossible to detect deception through analyses of

leakage of cues to affect, how can lie detection be accomplished? The research reviewed

here suggests that it is more fruitful to focus on the content of a person's speech than to

observe their nonverbal behavior, since the latter provides little valid information about

deceit. The implication of this is that in order for lie judgments to be reasonably accurate,

lie-catchers cannot simply observe targets. Instead, they should elicit verbal responses

from these targets, as verbal messages may be the carriers of cues to deceit.

   The proposition that lie-catchers ought to elicit verbal responses from targets fits

with an important paradigm shift in the literature on deception detection. In brief, this

paradigm shift involves moving from passive observation of behavior to the active elicitation of cues to deception (Vrij, Granhag, & Porter, 2010). This shift in the approach to lie detection is based on the now well-established finding that liars do not automatically leak behavioral cues. However, that the behavioral traces of deception are faint is not necessarily a universal fact: it may be possible to increase the behavioral differences between liars and truth tellers by exploiting some of the cognitive differences between the two. The approaches to elicit cues to deception are thus anchored in a *cognitive* rather than emotional model of deception. This model assumes that lying is a calculated, strategic enterprise that may demand cognitive and self-regulatory resources: Liars have to suppress the truth and formulate an alternative account that is sufficiently detailed to appear credible, while being mindful of the risk of contradicting particular details or one's own statement if one has to repeat it later on. Liars may experience greater self-regulatory busyness than truthful communicators, as a function of the efforts involved in deliberately creating a truthful impression (DePaulo et al., 2003).

Departing from this theoretical framework, it is possible to identify several different approaches to elicit behavioral differences between liars and truth tellers. First, if it is true that liars are operating under a heavier burden of cognitive load than truth tellers, imposing further cognitive load should hamper liars more than truth tellers. This hypothesis has been tested in several studies, in which cognitive load was manipulated (for example, by asking targets to tell the story in reverse order) and cues to deception were measured (e.g., Vrij et al., 2008; Vrij, Mann, Leal, & Fisher, 2010). In support of the cognitive load framework, cues to deception were more pronounced, and veracity judgments were more correct in the increased cognitive load conditions.

A related line of research has investigated whether it is possible to elicit cues to deception by exploiting the strategies liars employ in order to convince. For example, this research has attempted to elicit cues to deception by asking unanticipated questions, based on the assumption that liars plan some, but not all of their responses (Vrij et al., 2009). In line with the predictions, liars and truth tellers did not differ with regard to anticipated questions, but when unanticipated questions were asked, cues to deception emerged. Moreover, liars' verbal strategies of avoidance can be exploited through strategic use of background information, which elicits inconsistencies or contradictions between the target's statement and the background information (Hartwig et al., 2005; 2006). For an extensive discussion on approaches to elicit cues to deception, see Vrij et al. (2010).

Summary and directions for future research

In summary, the research reviewed above suggests that lie detection based on observations of behavior is a difficult enterprise. Hundreds of studies show that people obtain hit rates just slightly above the level of chance. This can be explained by the scarcity of cues to deception, as well as the finding that people report relying on behavioral cues that have little diagnostic value. A wave of research conducted during the last decade suggests that lie judgments can be improved by the elicitation of cues to deception through various methods of strategic interviewing. This wave of research has been accompanied by a theoretical shift in the literature, moving from an emotional model of deception towards a cognitive view of deception.

The SPOT program's focus on passive observations of behavior and its emphasis on emotional cues is thus largely out of sync with the developments in the scientific field. The evidence that accurate judgments of credibility can be made on the basis of such observations is simply weak. Of course, it must be acknowledged that engaging travelers in verbal interaction (ranging from casual conversations to more or less structured interviews) is more time-consuming and effortful than simply observing behaviors from some distance. Still, the literature on elicitation of cues to deception suggests that this approach is likely to be substantially more effective than passive observations of behavior.

Evaluation of the SPOT program. At the time this testimony is written, the DHS's report on the validation of the SPOT program has yet to be released. Therefore, I cannot comment on the methodological merits of this validation study. However, as requested, I will briefly outline some methodological processes that I would expect a validation study to follow. First, it would be necessary to establish clear operational definitions of the target(s) of the program. What is the program supposed to accomplish? In order to evaluate the outcomes of the program, such definitions are crucial. Moverover, I would expect analyses of the outcomes of the SPOT program using the framework of decision theory. That is, a validation study should minimally provide information about the frequency of hits, false alarms, misses and correct rejections (to do this, one must have an operational definition of what a hit is). Those values should be compared to chance expectations based upon the baserate of the defined target condition. Then the obtained outcomes should be compared to a screening protocol that does not include the key elements of the SPOT program. For example, the outcome of a comparable sample of

airports employing a random screening method may serve as an appropriate control group.

In addition to analyzing the results using a decision theory framework, it would be desirable to empirically examine the behavioral cues displayed by targets who pose threats to security, and compare them to targets who do not. That is, videotaped recordings of these targets (to the extent that they are available) should be subjected to detailed coding to determine the behavioral indicators that indicate deception and/or hostile intentions as these travelers move through an airport. The behaviors displayed by such targets should be compared to an appropriate control group, for example, a random sample of innocent travelers. The purpose of such analyses would be twofold: First, the results would empirically establish the behavioral indicators of deception and malicious intent in the airport setting. Second, the results could be compared to the SPOT criteria to establish whether there is an overlap between the two sets of indicators.

Moreover, it would be useful to evaluate the criteria on which Behavior Detection Officers rely to make judgments that a target is worthy of further scrutiny. That is, analyses of the behaviors of targets selected for scrutiny could be subjected to coding, to establish a) whether the officers rely on valid indicators of deception and hostile intentions and b) whether they rely on the criteria set forth in the SPOT training program. This would validate the SPOT program in a slightly different manner, as it would assess to what extent the Behavior Detection Officers follow the protocol of their training.

A problem of using field data is that important data will likely be missing. That is, while databases may include information about hits and false alarms from travelers who are subjected to further scrutiny, the data on misses and correct rejections are will be

incomplete. For example, misses may not be detected for years, if ever. For this reason it may be appropriate to subject the SPOT program to an experimental test, in which the ground truth about the travelers' status is known. The field and experimental approaches are obviously not mutually exclusive: It is possible (and perhaps even preferable) to conduct both types of validation studies, as the strength and weaknesses of each approach in terms of internal and external validity complement each other. A multi-methodological approach to validating the SPOT program may also provide convergent validity. If a concern with the laboratory approach is that participants in an experimental study would not be sufficiently motivated, it may be worth mentioning that it is possible to experimentally examine the effect of motivation on targets' behaviors within the context of a laboratory paradigm. Some targets could be randomly assigned to receive a weaker incentive for successfully passing through the screening, while others receive a stronger incentive. Of course, it would not be possible to create a fully realistic incentive system due to ethical considerations. Still, such a manipulation could provide some insight into the role of motivation in targets' behaviors, and to what extent motivation moderates the display of relevant behavioral cues.

In closing, I will briefly note a few areas of relevance for the airport security screening settings that I believe future research ought to focus on. First, most research has examined truths and lies about past actions. In the airport setting, truths and lies about future actions (intentions) may be of particular relevance. A few recent studies have examined true and false statements about future actions (Granhag & Knieps, in press; Vrij, Granhag, Mann, & Leal, in press; Vrij et al., in press). The studies reveal some findings in line with the research on true and false statements about past actions, for

example in that false statements about intentions are less plausible (Vrij et al., in press). However, there are also some differences in these results. While research on statements about past actions shows that lies are less detailed than truths, this finding has not been replicated for statements about future actions. However, this body of work is still small, and further empirical attention is needed.

Second, and relatedly, it would be valuable to attempt to extend the research findings on elicitation of cues to deception to airport settings. That is, it would be useful to establish to what extent it is possible to increase cues to deception using cognitive models when the statements concern future actions. Such knowledge could be translated into brief, standardized questioning protocols that could be used to establish the veracity of travelers' reports about both their past actions and their intentions.

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